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Accelerometer Based Gesture Recognisation for Wheel Chair Direction Control Using ZIGBEE Protocol

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***Abstract*— The aim of this work is to implement wheel chair direction control with hand gesture reorganization This paper proposes an integrated approach to real time detection, tracking and direction recognition of hands, which is intended to be used as a human-robot interaction interface for the intelligent wheelchair. This paper demonstrates that accelerometers can be used to effectively translate finger and hand gestures into computer interpreted signals. For gesture recognition the accelerometer data is calibrated and filtered. The accelerometers can measure the magnitude and direction of gravity in addition to movement induced acceleration. In order to calibrate the accelerometers, we rotate the device's sensitive axis with respect to gravity and use the resultant signal as an absolute measurement.**

Keywords- Gesture Recognition System, Human Robot Interface, Microcontroller, Receiver, Transmitter.

I. Introduction

Accelerometers can be used to effectively translate finger and hand gestures into computer interpreted signals. Integrating a single chip wireless solution with a MEMS accelerometer would yield an autonomous device small enough to apply to the fingernails because of their small size and weight. Accelerometers are attached to the fingertips and back of the hand. Arrows on the hand show the location of accelerometers and their sensitive directions. The sensitive direction of the accelerometer is in the plane of the hand. Micro-electromechanical systems (MEMS) are free scale's enabling technology for acceleration and pressure sensors. MEMS based sensor products provide an interface that can sense, process or control the surrounding environment. MEMS-based sensors are a class of devices that builds very small electrical and mechanical components on a single chip. MEMS-based sensors are a crucial component in automotive electronics, medical equipment, hard disk drives, computer peripherals, wireless devices and smart portable electronics such as cell phones and PDAs. MEMS technology provides the following advantages: cost-efficiency, low power, miniaturization, high performance, and integration. Functionality can be integrated on the same silicon or in the same package, which reduces the component count. This contributes to overall cost savings.

II. INTRODUCTION TO EMBEDDED SYSTEMS

Embedded System is a combination of hardware and software used to achieve a single specific task. An embedded system is a microcontroller-based, software driven, reliable, real-time control system, autonomous, or human or network interactive, operating on diverse physical variables and in diverse environments and sold into a competitive and cost conscious market.

An embedded system is not a computer system that is used primarily for processing, not a software system on PC or UNIX, not a traditional business or scientific application. High-end embedded & lower end embedded systems. High-end embedded system - Generally 32, 64 Bit Controllers used with OS. Examples Personal Digital Assistant and Mobile phones etc .Lower end embedded systems. Examples Small controllers and devices in our everyday life like Washing Machine, Microwave Ovens, where they are embedded in.

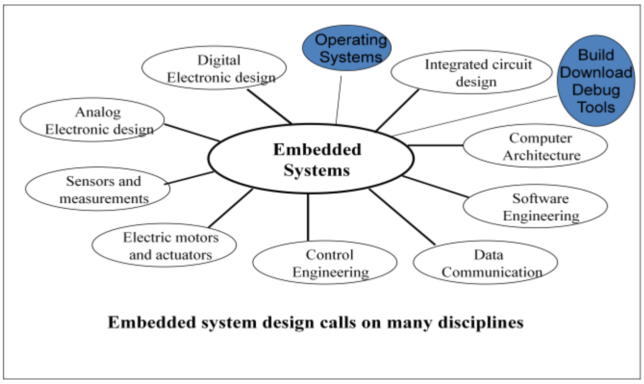


Figure 1. Embedded system design calls on many discilplines

III. TRANSMITTER MODULE

From the Fig. 2 accelerometer send the information about the tilt of the accelerometer sensor. This information is in the form of analog and the information of the tilt is in the form of x, y, z. the x, y, z axis information is indicate the position of the pointer. The data from the accelerometer is given to the ADC controller. The ADC controller can convert the analog information to the digital information for the micro controller understands. The micro controller can take the information from the ADC controller and spit the data in three forms. The

three forms are mentioning the identical position in third directionally of the pointer. The micro controller can sends the position of the pointer with the basic information from the accelerometer.

The reset logic is used to protect the internal program of the micro controller when the power spikes are present in the line current. And the oscillator is used to generate the clock for the micro controller to run the internal programs and clock of the micro controller.

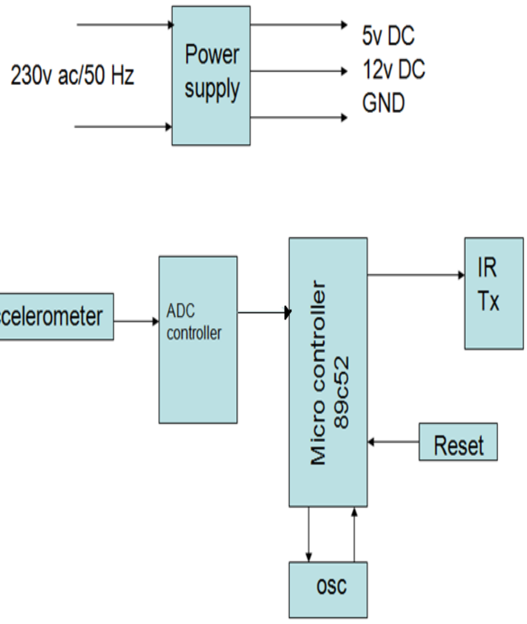
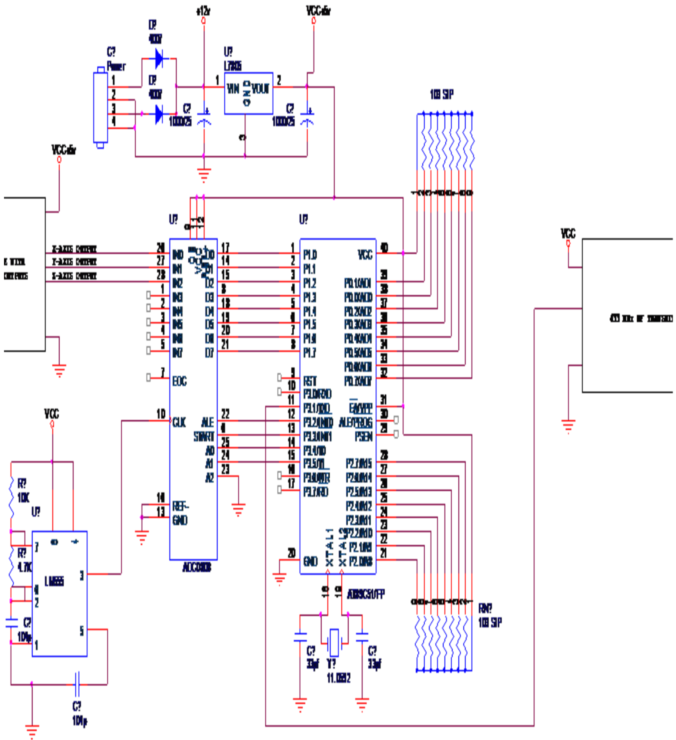


Figure 2. Block diagram of Transmitter

A. SCHEMATIC DIAGRAM OF TRANSMITTER



IV. RECEIVER MODULE

From the Fig. 3 the receiver having the IR receiver to receives the signal from the transmitter. This data will transmit by using IR rays. This signal will convert into equivalent digital signal that signal is given to the micro controller. The input of the micro controller is in the form of serial input data. The micro controller will take the input data and convert that data into equivalent hexadecimal data and given to the output to the output port. The output port is the construction of the PS/2 connector.

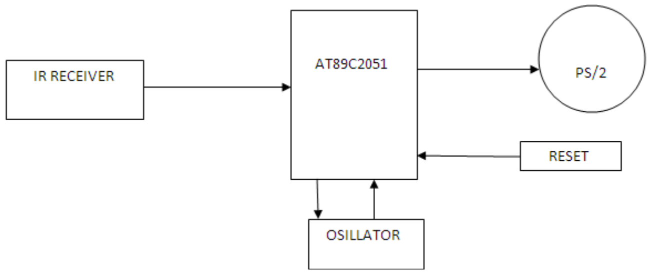
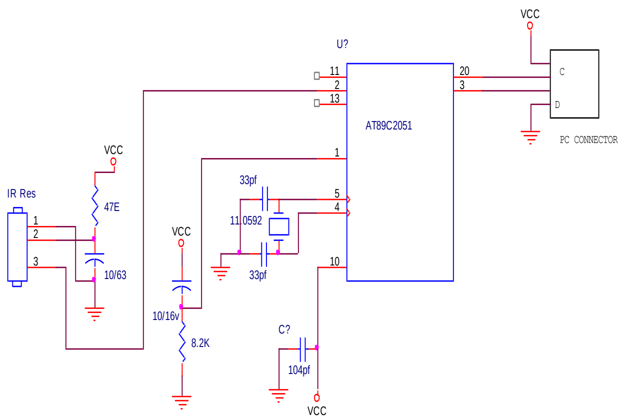


Figure 3. Block Diagram of Receiver

A. SCHEMATIC DIAGRAM OF RECEIVER



B. MICRO CONTROLLER (AT89C52)

The AT89C52 is 80C51 microcontrollers with 128kB Flash and 1024 bytes of data RAM.A key feature of the AT89C52 is its X2 mode option. The design engineer can choose to run the application with the conventional 80C51 clock rate (12 clocks per machine cycle) or select the X2 mode (6 clocks per machine cycle) to achieve twice the throughput at the same clock frequency. Another way to benefit from this feature is to keep the same performance by reducing the clock frequency by half, thus dramatically reducing the EMI.

The Flash program memory supports both parallel programming and in serial In-System Programming (ISP). Parallel programming mode offers gang-programming at high speed, reducing programming costs and time to market. ISP allows a device to be reprogrammed in the end product under software control. The capability to field/update the application firmware makes a wide range of applications possible. The AT89C52 is also In-Application Programmable (IAP), allowing the Flash program memory to be reconfigured even while the application is running.

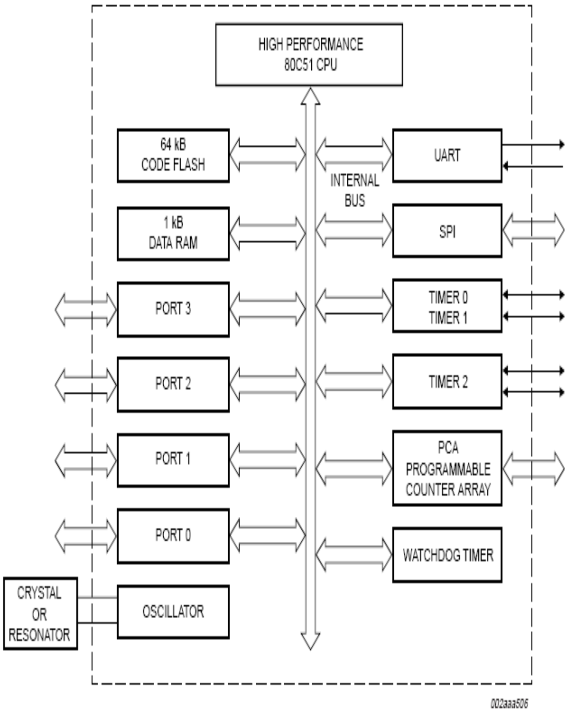


Figure 4. Block Diagram Of Micro Controller

C. FUNCTIONAL DESCRIPTION

1) Power-On reset code execution

Following reset, the AT89C52 will either enter the Soft ICE mode (if previously enabled via ISP command) or attempt to auto baud to the ISP boot loader. If this auto baud is not successful within about 400 ms, the device will begin execution of the user code.

D. IN-SYSTEM PROGRAMMING (ISP)

In-System Programming is performed without removing the microcontroller from the system. The In-System Programming facility consists of a series of internal hardware resources coupled with internal firmware to facilitate remote programming of the AT89C52 through the serial port. This firmware is provided by Atmel and embedded within each AT89C52 device. The Atmel In-System Programming facility has made in-circuit programming in an embedded application possible with a minimum of additional expense in components and circuit board area. The ISP function uses five pins (VDD, VSS, TxD, RxD, and RST). Only a small connector needs to be available to interface your application to an external circuit in order to use this feature.

Input/output (I/O) ports 32 of the pins are arranged as four 8-bit I/O ports P0–P3. Twenty-four of these pins are dual purpose with each capable of operating as a control line or part of the data/address bus in addition to the I/O functions. Details are as follows:

Port 0 : This is a dual-purpose port occupying pins 32 to 39 of the device. The port is an open-drain bidirectional I/O port with Schmitt trigger inputs. Pins that have 1s written to them float and can be used as high-impedance inputs. The port may be used with external memory to provide a multiplexed address and data bus. In this application internal pull-ups are used when emitting 1s. The port also outputs the code bytes during EPROM programming. External pull-ups are necessary during program verification.

Port 1: This is a dedicated I/O port occupying pins 1 to 8 of the device. The pins are connected via internal pull-ups and Schmitt trigger input. Pins that have 1s written to them are pulled high by the internal pull-ups and can be used as inputs; as inputs, pins that are externally pulled low will source current via the internal pull-ups. The port also receives the low-order address byte during program memory verification. Pins P1.0 and P1.1 could also function as external inputs for the third timer/counter i.e.:

(P1.0) T2 Timer/counter 2 external count input/clockout

(P1.1) T2EX Timer/counter 2 reload/capture/direction control

Port 2: This is a dual-purpose port occupying pins 21 to 28 of the device. The specification is similar to that of port 1. The port may be used to provide the high-order byte of the address bus for external program memory or external data memory that uses 16-bit addresses. When accessing external data memory that uses 8-bit addresses, the port emits the contents of the P2 register. Some port 2 pins receive the high-order address bits during EPROM programming and verification.

Port 3: This is a dual-purpose port occupying pins 10 to 17 of the device. The specification is similar to that of port 1. These pins, in addition to the I/O role, serve the special features of the 80C51 family *B.*

V. ACCELARATORS

A. CONVERTING ACCELERATIONS

Fig. 5 shows the axis orientation of the MMA7260QT. The positive signs along *x*-, *y*-, and *z*-axis (with arrows indicated) define the direction that the sensor is accelerated to. The outputs from the MMA7260QT are analog signals with maximal bandwidth response of 350Hz (*x*- and *y*-axis) and 150Hz (*z*-axis). For any axis with no applied acceleration, its output is equal to half the supply voltage (*VDD*). The output voltage increases from the half *VDD* level when the sensor is accelerated in the positive direction along its sensitive axis. On the contrary, the signal output is below the half *VDD* level when the sensor is accelerated in negative direction (or decelerated) along its sensitive axis.

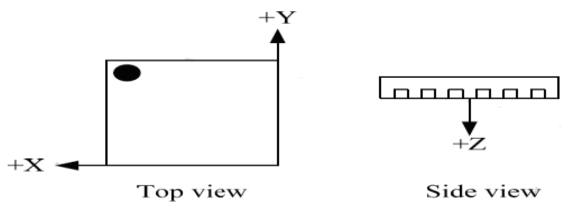


Figure 5. Axis orientation of the MMA7260QT

For a typical *VDD*=3.3V application, the zero-acceleration output is 0.5×3.3=1.65V. When the sensor is accelerated, the outputs of the sensitive axes deviate from 1.65V and the variation is according to the selected sensitivity *S* (mV/g, voltage per gravity) as shown in Table I For example, if 2g sensitivity is selected, its sensitivity is 600mV/g (g is gravity in the amount of 9.81m/s2) and the voltage within the sensitivity range changes linearly with the measured acceleration (*Acc*).

Sensitivity can be selected with 2 logic inputs connected to pin g-Select 1 and g-Select 2. The sensitivity can be changed at anytime during operation. The g-select pins of the MMA7260QT can be configured with high (1) or low (0) status by microcontroller outputs, as shown in Table I. The g-select

pins can be left unconnected for applications only requiring 1.5g selectivity.

The Sleep Mode pin can be connected to a logic inputs for mode switch. Set this pin low to enable MMA7260QT in Sleep Mode that will only consumed trickle current. A high logic input at this pin will switch the sensor to normal operation mode.

B. TILT SENSING

The MMA7260QT can respond to gravity or constant acceleration due to its capacitive detection principle and mechanism. When gravity is perpendicular to an axis, its axis output is zero-acceleration and therefore is half the *VDD* (i.e., 1.65V for typical 3.3V application). When gravity is parallel to an axis and the gravity direction is toward the positive direction of that axis, its axis output is half the *VDD* plus the selected sensitivity

TABLE I. THE MMA7260QT OUTPUTS WITH RESPECT TO DIFFERENT SENSOR ORIENTATIONS (*VDD*=3.3V, 2G SENSITIVITY)

Orientation / Outputs (V_{out})					Top / Bottom	Bottom / Top
x-axis	1.65	2.25	1.65	1.05	1.65	1.65
y-axis	2.25	1.65	1.05	1.65	1.65	1.65
z-axis	1.65	1.65	1.65	1.65	2.25	1.05

The gravity response capability of the MMA7260 is useful for accurate tilt sensing with respect to any orthogonal planes. Assume the φ, ρ and θ are the tilt angles of X-,Y- and Z-axis with respect to horizon, respectively with known accelerations all the three tilt angles follow sinusoidal relationship.

$$\phi = \arcsin(A_{CC_x})$$

$$\rho = \arcsin(A_{CC_y})$$

$$\theta = \arcsin(A_{CC_z})$$

The resolution (acceleration changed per degree, i.e., the slope the sinusoidal curve) for any axis also varies with tilt angles due to the sinusoidal relationship. Take the x-axis for example, the maximal resolution can be obtained when its tilt φ increases from 0° or 180°, and the minimal resolution occurs at φ approaches 90° or 270°. Therefore a modified tilt calculation is suggested and is valid and applicable because it combines other axis outputs and therefore a maximal resolution of tilt sensing can be retained across any rotation and orientation with respect to any axis.

$$\phi = \arctan\left(\frac{A_{CC_x}}{\sqrt{A_{CC_y}{}^2 + A_{CC_z}{}^2}}\right)$$

$$\rho = \arcsin\left(\frac{A_{CC_y}}{\sqrt{A_{CC_x}{}^2 + A_{CC_z}{}^2}}\right)$$

$$\theta = \arcsin\left(\frac{A_{CC_z}}{\sqrt{A_{CC_x}{}^2 + A_{CC_y}{}^2}}\right)$$

The block diagram of the three axis accelerometer MMA7260QT is as shown in the Fig. 6. The various components of the accelerometer sensor can be known from the block diagram.

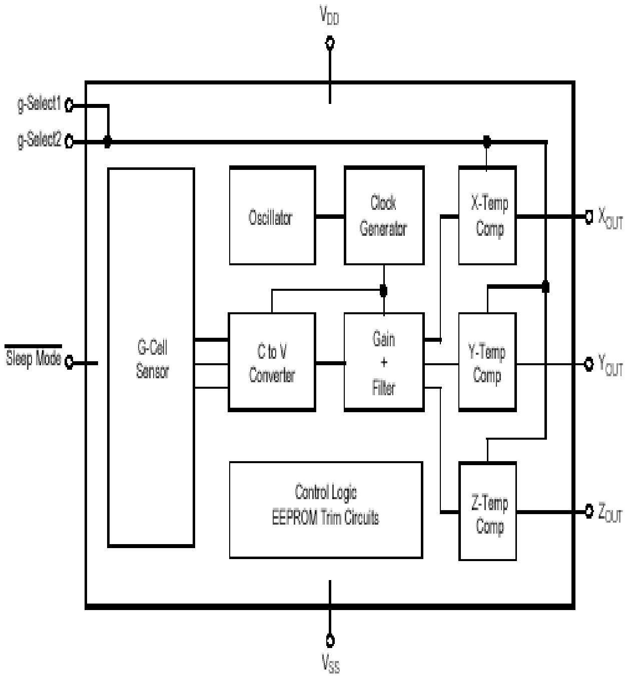


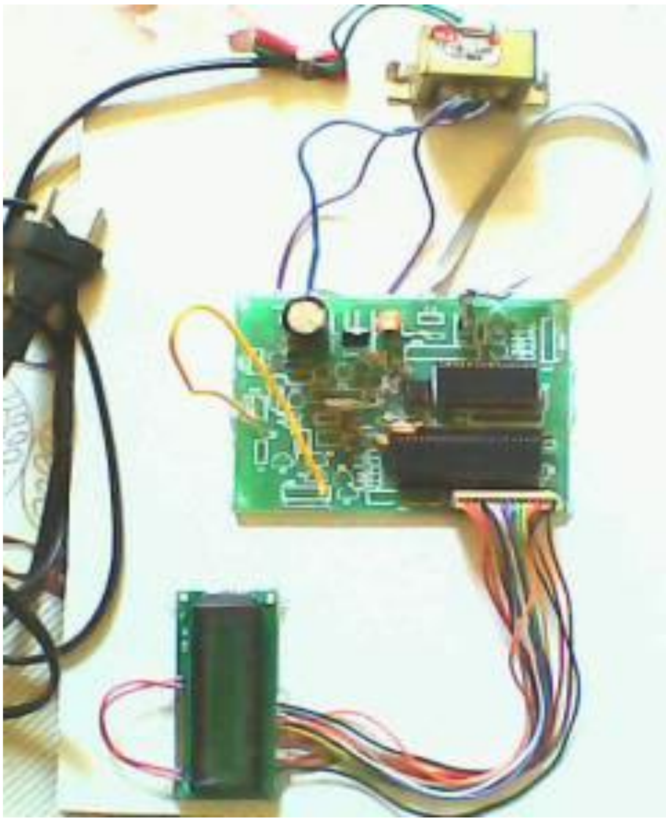
Figure 6. Simplified accelerometer functional diagram

VI. LIQUID CRYSTAL DISPLAY

In 1968, RCA Laboratories developed the first liquid crystal display (LCD). Since then, LCD's have been implemented on almost all types of digital devices, from watches to computer to projection TVs .LCD's operate as a light "valve", blocking light or allowing it to pass through. An image in an LCD is formed by applying an electric field to alter the chemical properties of each LCC (Liquid Crystal Cell) in the display in order to change a pixel's light absorption properties as shown in Fig.7. These LCC's modify the image produced by the backlight into the screen output requested by the controller. Through the end output may be in color, the LCC's are monochrome, and the color is added later through a filtering process. Modern laptop computer displays can produce 65,536 simultaneous colors at resolution of 800 X 600.

Figure 7. Diagram of 16x2 LCD

VII. KIT DIAGRAM



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